

5409. (new) The method of claim 5404, further comprising controlling a pressure and a temperature within at least a majority of the pyrolysis zone, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

5410. (new) The method of claim 5404, wherein providing heat from the heaters to the portion of the formation comprises:

heating a selected volume (V) of the formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

Response To Office Action Mailed July 9, 2002

A. Pending Claims

Claims 2193-2269, 5396-5397, and 5398-5413 are currently pending. Claims 2193-2202, 2204, 2219, 2224, 2226-2241, 2243, 2258, 2263, 2265-2269, and 5396-5397 have been amended. Claims 5398-5410 are new.

B. Election of Species

In item 1 of the Office Action, the Examiner states: "Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable." Applicant elects the species of heater described in claim 2199, claim 2238 and in new claim 5408, without traverse. The generic name of the elected species is: "natural distributed combustor." Applicant reserves the right for consideration of claims to additional species written in dependent form upon allowance of a generic claim.

vaporization of the hydrocarbon. Camacho does not appear to teach or suggest operation to result in the claimed feature of a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C)

In the Office Action, the Examiner states: “The steps of 2219-2222, 2228, 2258-2261, 2266 such as controlling the heat or pressure in the formation, are deemed obvious matters of choice or design in carrying out the process of Camacho et al. In this regard, Camacho et al teaches that steam injection temperature, pressure and/or volume may be controlled in response to monitoring of the fluid products. In addition, overall operating conditions within the hydrocarbon formation may be altered (noted col. 5, lines 20-27) to vary the product fluid composition(s).” Applicant respectfully disagrees that the features of the claims are obvious matters of choice or design.

Claims 2219 and 2258 describe a combination of features including: “controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.” Camacho does not appear to teach or suggest controlling a pressure within at least a majority of the part of the formation. Camacho appears to teach injection of steam to react with a surface of the formation that is at a very high temperature. Camacho appears to teach or suggest the use of steam injection to control pressure adjacent to the formation, not within the formation. Applicant submits that at least the above quoted features in claims 2219 and 2258, in combination with the other features of the claims, does not appear to be taught or suggested by the cited art.

Claims 2222 and 2261 describe a combination of features including: “altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.” Camacho appears to teach or suggest “initial heat supplied to the coal serves to strip the volatiles from the surrounding coal. The steam serves as a reactant to aid in the gasification of the fixed carbon component ...” (Col 7, lines 49-52). Camacho does not appear to teach or suggest altering a pressure to inhibit production of hydrocarbons with carbon numbers greater than 25. Applicant submits that at least the above quoted features of

claims 2222 and 2261, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Claims 2228 and 2266 describe a combination of features including: “controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by a Fischer Assay.” Camacho appears to teach or suggest gasification of hydrocarbons at high temperature with steam. Camacho does not appear to teach or suggest production of 60% by weight of condensable hydrocarbons. Applicant submits that at least the quoted feature of claims 2228 and 2266, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Applicant submits that controlling and/or altering the pressure or heat as recited in claims 2219-2222, 2228, 2258-2261, and 2266 provides unexpected and/or improved results based on the prior art. For example, Applicant’s specification states:

Controlling pressure, heat and/or heating rates of a selected section in a formation may increase production of selected formation fluids. For example, the amount and/or rate of heating may be controlled to produce formation fluids having an American Petroleum Institute (“API”) gravity greater than about 25. Heat and/or pressure may be controlled to inhibit production of olefins in the produced fluids.

Controlling formation conditions to control the pressure of hydrogen in the produced fluid may result in improved qualities of the produced fluids. In some embodiments it may be desirable to control formation conditions so that the partial pressure of hydrogen in a produced fluid is greater than about 0.5 bar absolute, as measured at a production well.
(Specification, page 17, lines 13-22).

Applicant’s specification further discloses:

In an embodiment, a pressure within a heated portion of the formation may surprisingly increase the quality of relatively high quality pyrolyzation fluids, the quantity of relatively high quality pyrolyzation fluids, and/or vapor phase transport of the pyrolyzation fluids within the formation. Increasing the pressure often permits production of lower molecular weight hydrocarbons since such lower molecular weight hydrocarbons will more readily transport in the vapor phase in the formation. Generation of lower molecular weight hydrocarbons (and

corresponding increased vapor phase transport) is believed to be due, in part, to autogenous generation and reaction of hydrogen within a portion of the hydrocarbon containing formation. For example, maintaining an increased pressure may force hydrogen generated in the heated portion into a liquid phase (e.g. by dissolving). In addition, heating the portion to a temperature within a pyrolysis temperature range may pyrolyze at least some of the hydrocarbons within the formation to generate pyrolyzation fluids in the liquid phase. The generated components may include a double bond and/or a radical. H₂ in the liquid phase may reduce the double bond of the generated pyrolyzation fluids, thereby reducing a potential for polymerization of the generated pyrolyzation fluids. In addition, hydrogen may also neutralize radicals in the generated pyrolyzation fluids. Therefore, H₂ in the liquid phase may substantially inhibit the generated pyrolyzation fluids from reacting with each other and/or with other compounds in the formation. In this manner, shorter chain hydrocarbons may enter the vapor phase and may be produced from the formation.

Increasing the formation pressure to increase the amount of pyrolyzation fluids in the vapor phase may significantly reduce the potential for coking within the selected section of the formation. A coking reaction may occur in the liquid phase. Since many of the generated components may be transformed into short chain hydrocarbons and may enter the vapor phase, coking within the selected section may decrease.

Increasing the formation pressure to increase the amount of pyrolyzation fluids in the vapor phase is also beneficial because doing so permits increased recovery of lighter (and relatively high quality) pyrolyzation fluids. In general, pyrolyzation fluids are more quickly produced, with less residuals, when such fluids are in the vapor phase rather than in the liquid phase. Undesirable polymerization reactions also tend to occur more frequently when the pyrolyzation fluids are in the liquid phase instead of the vapor phase. In addition, when pyrolyzation fluids are produced in the vapor phase, fewer production wells/area are needed, thereby reducing project costs.

(Specification, page 130, line 16 to page 131, line 18).

Thus, Applicant submits that controlling and/or altering the pressure or heat as recited in claims 2219-2222, 2228, 2258-2261, and 2266 are not obvious matters of choice or design. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertions of obvious matter of choice or design, either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

In the Office Action, the Examiner states: "Regarding claims 2229-2231, 2267-2269,

5396, 5397, Camacho et al in the embodiment of Figure 10 discloses that myriad heating wells (65) surround a production well or shaft (74). The precise number of such heating wells provided, as called for in these claims, is deemed an obvious matter of choice or design in carrying out the process of Camacho et al based on, e.g., the overall areal extent of the hydrocarbon formation(s) encountered in exploiting an actual reservoir encountered in the field.” Applicant respectfully disagrees.

Claims 2229 and 2267 describe a combination of features including: “producing a mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.” Each well of Camacho appears to be a production well. Applicant submits that at least the above quoted features of claims 2229 and 2267, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Claims 5396 and 5397 describe a combination of features including: “wherein at least about 20 heaters are disposed in the formation for each production well.” Each well of Camacho appears to be a production well. Applicant submits that at least the above quoted features of claims 5396 and 5397, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Applicant requests removal of the obviousness rejection of claims 2201-2204, 2219-2222, 2228-2231, 2240-2243, 2258-2261, 2266-2269, 5396, and 5397.

G. The Claims Are Not Obvious Over Camacho or Justheim In View of Hoekstra or Garrett Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2225 and 2264 as being unpatentable under 35 U.S.C. § 103(a) over Camacho as applied to claim 2232, and further in view of U.S. Patent No. 4,353,418 to Hoekstra et al. (hereinafter “Hoekstra”) or U.S. Patent No. 3,661,423 to Garrett (hereinafter “Garrett”). The Examiner also rejected claims 2225 and 2264 as being unpatentable over Justheim in view of Hoekstra or Garrett. Applicant respectfully disagrees that the claims are

obvious in light of the cited art.

Claims 2225 describes a combination of features including: “allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of at least a portion of the part of the formation increases to greater than about 100 millidarcy.” The combination of Camacho or Justheim with Hoekstra or Garrett does not appear to teach or suggest at least the quoted feature, in combination with the other features of claim 2225. Claim 2264 describes a combination of features including: “allowing the heat to transfer from the one or more heaters to a selected section of the formation such that a permeability of a majority of at least a portion of the selected section increases substantially uniformly.” The combination of Camacho or Justheim with Hoekstra or Garrett do not appear to teach or suggest at least the quoted feature, in combination with the other features of claim 2264.

H. The Claims Are Neither Anticipated By, Nor Obvious Over Justheim Pursuant To 35 U.S.C. § 102(b) or 103(a) Respectively

The Examiner rejected claims 2193, 2195, 2199, 2205-2218, 2226, 2227, 2232, 2234, and 2244-2257 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,766,982 to Justheim (hereinafter “Justheim”). Applicant respectfully disagrees with these rejections.

Claim 2193 and claim 2232 describe combinations of features, each including the feature of “providing heat from one or more heaters to a portion of the formation; ...” Justheim does not appear to teach or suggest at least this feature of each of claims 2193 and 2232, in combination with the other individual features of each of the claims.

The Examiner states “It is further deemed that such permeability increase will inherently or obviously be substantially “uniform”, as called for in claims 2232, 2227, and 5196, e.g. since the injected heated air which causes the permeability increase permeates throughout the hydrocarbonaceous formation.” Applicant respectfully disagrees that the permeability will

inherently or obviously increase. Justheim teaches injecting heated air into a formation. Injection of a heated fluid may preferentially flow through channels or fractures in the formation. Such preferential flow would inhibit the formation of uniform permeability and/or a permeability greater than 100 millidarcy.

Applicant believes that many of the dependent claims of independent claims are independently patentably over the cited art. For example, claim 2226 describes a combination of features including: “further comprising increasing a permeability of a majority of the part of the formation to greater than about 5 Darcy.” At least this feature of claim 2226, in combination with the other features of the claim, does not appear to be taught, suggested or an obvious design choice in light of Justheim. Claim 2227 recites, in part “wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.” At least this feature, in combination with the other features of claim 2227, does not appear to be taught or suggested by Justheim.

Claims 2195 and 2234 describe a combination of features including: “maintaining a temperature within the part of the formation within a pyrolysis temperature range.” Applicant submits that the combination of features in claims 2195 and 2234, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Claim 2199 recites, in part “wherein one or more of the heaters comprise natural distributed combustors.” The features of claim 2199, in combination with the features of independent claim 2193, do not appear to be taught or suggested by the cited art.

In the Office Action, the Examiner stated: “Regarding claims 2205-2218 and 2244-2257, it is deemed that the myriad hydrocarbon product mixtures recited in these claims would necessarily or obviously occur in carrying out the heating process of Justheim, i.e., the precise composition of the product fluids is seen as dictated by the particular hydrocarbon naturally occurring in the particular formation actually encountered in the field.” Applicant respectfully disagrees.

Applicant submits that the product mixtures recited in claims 2205-2218 and 2244-2257 would not be producible by carrying out the heating process of Justheim. The product mixtures recited in claims 2205-2218 and 2244-2257 may be produced by controlling and/or modifying formation conditions (as claimed in claims 2205-2218 and 2244-2257) during treatment to produce the selected results recited in the claims. Applicant submits that the product mixtures recited in claims 2205-2218 and 2244-2257 would not inherently or obviously occur in carrying out the heating process of Justheim.

I. The Claims Are Not Obvious Over Justheim Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2201-2204, 2219-2224, 2228, 2240-2243, 2258-2263, and 2266 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,766,982 to Justheim. Applicant respectfully disagrees with these rejections.

In the Office Action, the Examiner states: “The precise heating rate and thermal conductivity recited in claims 2201, 2202, 2240, 2241 are deemed obvious matters of choice or design based on, e.g., the quality and amount of the in place hydrocarbon present in the particular hydrocarbonaceous formation encountered in the field in carrying out the process of Justheim.” Applicant respectfully disagrees.

Claims 2201 and 2240 describe a combination of features including: “controlling the heat such that an average heating rate of a part of a formation is less than about 1 °C per day during pyrolysis.” Applicant submits that at least the quoted features of claims 2201 and 2240, in combination with the other features the claims, do not appear to be taught or suggested by the cited art.

Claims 2202 and 2241 describes a combination of features including: “heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some

C. The Claims Are Not Indefinite Pursuant To 35 U.S.C. § 112, Second Paragraph

Claims 2208-2211, 2247-2250, 5396, and 5397 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner states “Claims 2208-2111 and 2247-2250 are indefinite because, insofar as a “hydrocarbon”, by definition, comprises organic compounds consisting only of carbon and hydrogen, the recited “condensable hydrocarbons” cannot include nitrogen, oxygen, sulfur and/or oxygen-containing compounds.” Applicant respectfully disagrees.

Applicant respectfully submits that Applicant has used an accepted meaning of the term “hydrocarbon” as defined by one of ordinary skill in the art. Support for this definition can be found in references within and associated with the art of the petroleum industry. For example, a reference within the art gives the following definition: “**Hydrocarbons:** molecules formed primarily by carbon and hydrogen atoms” (Hyne, N. J. *Geology for Petroleum Exploration, Drilling, and Production*, 1984, McGraw-Hill Book Company, pg. 264). The Specification (page 38, paragraph beginning on line 14) has been amended for clarification. Applicant requests removal of the rejections of claims 2208-2211, 2247-2250, 5396, and 5397.

D. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 2193-2269, 5396, and 5397 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over copending U.S. Patent Applications:

09/841,936; 09/841,937; 09/841,000; 09/841,060; 09/841,061; 09/841,127; 09/841,128; 09/841,129; 09/841,130; 09/841,131; 09/841,170; 09/841,193; 09/841,194; 09/841,195; 09/841,238; 09/841,239; 09/841,240; 09/841,283; 09/841,284; 09/841,285; 09/841,286; 09/841,287; 09/841,288; 09/841,289; 09/841,290; 09/841,291; 09/841,292; 09/841,293; 09/841,294; 09/841,295; 09/841,296; 09/841,297; 09/841,298; 09/841,299; 09/841,300; 09/841,301; 09/841,302; 09/841,303; 09/841,304; 09/841,305; 09/841,306; 09/841,307;

09/841,308; 09/841,309; 09/841,310; 09/841,311; 09/841,312; 09/841,429; 09/841,430;
09/841,431; 09/841,432; 09/841,433; 09/841,434; 09/841,435; 09/841,436; 09/841,437;
09/841,438; 09/841,439; 09/841,440; 09/841,441; 09/841,442; 09/841,443; 09/841,444;
09/841,445; 09/841,446; 09/841,447; 09/841,448; 09/841,449; 09/841,488; 09/841,489;
09/841,490; 09/841,491; 09/841,492; 09/841,493; 09/841,494; 09/841,495; 09/841,496;
09/841,497; 09/841,498; 09/841,499; 09/841,500; 09/841,501; 09/841,502; 09/841,632;
09/841,633; 09/841,634; 09/841,635; 09/841,636; 09/841,637; 09/841,638; and 09/841,639.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is also inconsistent with certain restrictions issued in the above-referenced cases. Applicant respectfully requests reconsideration.

Pursuant to a discussion in an Examiner interview on August 19, 2002, for the convenience of the Examiner, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner. Applicant understands that the Examiner will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

E. The Claims Are Neither Anticipated By, Nor Obvious Over Camacho Pursuant To 35 U.S.C. § 102(b) or 103(a) Respectively

The Examiner rejected claims 2193, 2195, 2205-2218, 2226, 2227, 2230-2232, 2234, 2244-2257, 2268, and 2269 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,067,390 to Camacho et al. (hereinafter "Camacho"). Applicant respectfully disagrees with these rejections.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed. Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed. Cir. 1985).

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 U.S.P.Q. 173, 177-178 (C.C.P.A. 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

The Examiner states “Such permeability increase is deemed to necessarily or inherently encompass an increase to “greater than about 100 millidarcy” or “greater than about 5 Darcy”, as called for in claims 2193, 2226, 5175; alternatively, to increase the permeability to greater than 100 millidarcy or 5 Darcy would have been an obvious matter of choice in order to ensure adequate fluid flow through the formation.” Applicant respectfully disagrees that the increase in permeability is necessary, inherent or an obvious matter of choice.

Amended claim 2193 describes a combination of features including: “allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of at least a portion of the part of the formation increases to greater than about 100 millidarcy.” Applicant submits that support for the amendment can be found at least in the specification on page 40, lines 1-3. “A “heater” is generally defined as any system configured to generate heat in a well or a near wellbore region.” (Specification, page 40, lines 6-7). Applicant submits that at least allowing heat to transfer to a part of the formation to increase a permeability to great than about 100 millidarcy, in combination with the other features of the claim, does not appear to be taught or suggested by the cited art. Applicant respectfully submits that the Examiner’s rejection of the features of claim 2193 as obvious matters of choice or design relies upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant’s attention. Otherwise, Applicants request this rejection be removed. *See, e.g.*, MPEP 2143.01. Applicant submits Camacho does not appear to teach all of the features in claim 2193 and the claims dependent thereon.

The Examiner states "It is further deemed that such permeability increase will inherently or obviously be substantially uniform, as called for in claims 2232, 2227, 5196 as illustrated in Figures 4 and 5." Applicant respectfully disagrees that the permeability will inherently or obviously be substantially uniform.

Amended claim 2232 describes a combination of features including: "allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform" Camacho appears to teach or suggest rapidly heating the formation. Such rapid heating appears to remove the formation (gasification of coal) which does not increase the permeability, since the formation is gone. The heat front produced by the plasma torches of Camacho would likely coke adjacent non-gasified coal and therefore reduce or eliminate permeability in such coal. Applicant submits that at least the above quoted features of claim 2232, in combination with the other features of the claim, do not appear to be taught or suggested by the cited art.

If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Applicant submits, however, that many of the claims dependent on claims 2193 and 2232 are separately patentable.

For example, claim 2226 describes a combination of features including: "further comprising increasing a permeability of a majority of the part of the formation to greater than about 5 Darcy." Applicant submits that at least the above quoted features of claim 2226, in combination with the other features of the claim, do not appear to be taught or suggested by the cited art. Applicant respectfully submits that the Examiner's rejection of the features of claim 2226 as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request

this rejection be removed. *See, e.g.*, MPEP 2143.01.

Claim 2227 recites, in part “wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.” At least these features of claim 2227, in combination with the other features of the claim, do not appear to be taught or suggested by the cited art.

Claims 2195 and 2234 describe a combination of features including: “maintaining a temperature within the part of the formation within a pyrolysis temperature range.” Camacho appears to teach quickly raising a temperature of a face of the formation to a temperature above the pyrolysis temperature range. Applicant submits that at least the quoted features of claims 2195 and 2234, in combination with the other features of the claims, do not appear to be taught by the cited art.

In the Office Action, the Examiner stated: “Regarding claims 2205-2218 and 2244-2257, it is deemed that the myriad hydrocarbon product mixtures recited in these claims would necessarily or obviously occur in carrying out the heating process of Camacho et al, i.e., the precise composition of the product fluids is seen as dictated by the particular hydrocarbon naturally occurring in the particular formation actually encountered in the field.” Applicant submits that the product mixtures recited in claims 2205-2218 and 2244-2257 would not be producible by carrying out the heating process of Camacho. The process conditions dictated in Camacho would not appear to teach or suggest the ability to produce product mixtures as claimed in claims 2205-2218 and 2244-2257. The Examiner appears to be unjustifiably extending the teaching of Camacho. Applicant requests the removal of the rejections of claims 2205-2218 and 2244-2257.

F. The Claims Are Not Obvious Over Camacho Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2201-2204, 2219-2222, 2228-2231, 2240-2243, 2258-2261, 2266-2269, 5396, and 5397 under 35 U.S.C. 103(a) as obvious over U.S. Patent No.

4,067,390 to Camacho et al. Applicant respectfully disagrees with these rejections.

In the Office Action, the Examiner states: "The precise heating rate and thermal conductivity recited in claims 2201, 2202, 2240, 2241 are deemed obvious matters of choice or design based on, e.g., the quality and amount of the in place hydrocarbon present in the particular hydrocarbon formation encountered in the field, consistent with objective of Camacho to provide a low rate of heating (col. 10, lines 34-40)." Applicant respectfully disagrees.

Claims 2201 and 2240 describe a combination of features including: "controlling the heat such that an average heating rate of a part of a formation is less than about 1 °C per day during pyrolysis." Camacho's objective for the "low rate" of heating appears to be to avoid glazing the formation, not to "heat such that an average heating rate of a part of a formation is less than about 1 °C per day during pyrolysis." Applicant submits that the combination of features in claims 2201 and 2240, do not appear to be taught or suggested by the cited art.

Claims 2202 and 2241 describes a combination of features including: "heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day." Camacho appears to teach or suggest the use of a plasma torch that is operated with a range of three to fifteen million BTU/hr (see col 10, lines 34-40). Camacho does not appear to teach or suggest a heating energy/day (Pwr) provided to the selected volume that is equal to or less than $h * V * C_v * \rho_B$.

Applicant submits that the Examiner's rejection of the features of claims 2201, 2202, 2240, and 2241, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either

by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.*, MPEP 2143.01.

Camacho appears to teach heating the formation at a relatively high heating rate. Camacho appears to teach using a heat output of about 219,800 watts per meter to about 1,099,015 watts per meter. Applicant does not believe that the use of a heating rate that is orders of magnitude lower than the heating rate taught and suggested by the cited art would be obvious in light of the cited art. Applicant submits that the teachings and suggestions of Camacho would not allow the heating of a formation at the heating rates suggested in claims 2201, 2202, 2240, and 2241.

Claims 2203 and 2242 describe a combination of features including: "allowing the heat to transfer comprises transferring heat substantially by conduction." At least the above quoted feature, in combination with the other features of the claims, does not appear to be taught or suggested by the cited art.

In the Office Action, the Examiner states: "The thermal conductivity recited in claims 2204 and 2243 is deemed an obvious matter of choice or design based on, e.g., the quality and amount of the in place hydrocarbon present and/or the matrix of characteristics of the particular hydrocarbon formation encountered in the field." Applicant respectfully disagrees.

Amended claims 2204 and 2243 describe a combination of features including: "providing heat from one or more of the heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C)." Applicant submits that at least this feature, in combination with the other features of the claims, does not appear to be taught or suggested by the cited art.

Applicant submits that providing heat from one or more heaters such that a thermal conductivity of a portion of a formation is greater than about 0.5 W/(m °C) is unexpected based on literature in the art. For example, Applicant's specification states:

Certain embodiments described herein will in many instances be able to economically treat formations that were previously believed to be uneconomical. Such treatment will be possible because of the surprising increases in thermal conductivity and thermal diffusivity that can be achieved with such embodiments. These surprising results are illustrated by the fact that prior literature indicated that certain hydrocarbon containing formations, such as coal, exhibited relatively low values for thermal conductivity and thermal diffusivity when heated. For example, in government report No. 8364 by J. M. Singer and R. P. Tye entitled "Thermal, Mechanical, and Physical Properties of Selected Bituminous Coals and Cokes," U.S. Department of the Interior, Bureau of Mines (1979), the authors report the thermal conductivity and thermal diffusivity for four bituminous coals. This government report includes graphs of thermal conductivity and diffusivity that show relatively low values up to about 400 °C (e.g., thermal conductivity is about 0.2 W/(m °C) or below, and thermal diffusivity is below about 1.7×10^{-3} cm²/s). This government report states that "coals and cokes are excellent thermal insulators."

In contrast, in certain embodiments described herein hydrocarbon containing resources (e.g., coal) may be treated such that the thermal conductivity and thermal diffusivity are significantly higher (e.g., thermal conductivity at or above about 0.5 W/(m °C) and thermal diffusivity at or above 4.1×10^{-3} cm²/s) than would be expected based on previous literature such as government report No. 8364. If treated as described in certain embodiments herein, coal does not act as "an excellent thermal insulator." Instead, heat can and does transfer and/or diffuse into the formation at significantly higher (and better) rates than would be expected according to the literature, thereby significantly enhancing economic viability of treating the formation.

(Specification, page 150, line 18 to page 151, line 10).

Thus, Applicant submits that providing heat from one or more heaters and heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C) is not an obvious matter of choice or design. Applicant respectfully submits that the Examiner's rejection of the features of claims 2204 and 2243, in combination with the features of independent claims 2193 and 2232 respectively, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.*, MPEP 2143.01. Camacho appears to rely on radiative heat transfer and

hydrocarbons within the selected volume of the formation; and wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.”

Applicant submits that at least the quoted features of claims 2202 and 2241, in combination with the other features the claims, do not appear to be taught or suggested by the cited art.

Claims 2203 and 2242 describe a combination of features including: “allowing the heat to transfer comprises transferring heat substantially by conduction.” Justheim appears to teach or suggest transfer of heat by convective heat transfer. The above quoted feature of claims 2203 and 2242, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Claims 2204 and 2243 describe a combination of features including: “providing heat from one or more of the heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).” Applicant submits that providing heat from one or more heaters such that a thermal conductivity of a portion of a formation is greater than about 0.5 W/(m °C) is unexpected based on literature in the art as outlined above in Section F as regards Camacho. Applicant submits that at least the quoted feature of claims 2204 and 2243, in combination with the other features of the claims, do not appear to be taught, suggested, inherent or obvious design choice in light of the cited art.

In the Office Action, the Examiner states: “The steps of 2219, 2222, 2228, 2258, 2261, 2266 such as controlling the heat or pressure in the formation, are deemed obvious matters of choice or design in carrying out the process of Justheim.” Applicant submits that controlling and/or altering the pressure or heat as recited in claims 2219, 2222, 2228, 2258, 2261, and 2266 provides unexpected and/or improved results based on the prior art as outlined in Section F as regards Camacho and claims 2219-2222, 2228, 2258-2261, and 2266. Applicant submits that controlling and/or altering the pressure or heat as recited in claims 2219, 2222, 2228, 2258, 2261, and 2266 are not obvious matters of choice or design.

Claims 2228 and 2266 describe a combination of features including: “controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by a Fischer Assay.” Justheim does not appear to teach or suggest at least the quoted feature of claims 2228 and 2266, in combination with the other features of the claims. The Examiner appears to be impermissibly extending the teachings of Justheim.

Applicant requests removal of the obviousness rejection of claims 2201-2204, 2219-2224, 2228, 2240-2243, 2258-2263, and 2266.

J. The Claims Are Not Obvious Over Justheim In View of Hoekstra or Garrett Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2225 and 2264 as being unpatentable under 35 U.S.C. §103(a) over U.S. Patent No. 3,766,982 to Justheim as applied to claim 2193, and further in view of U.S. Patent No. 4,353,418 to Hoekstra et al., or U.S. Patent No. 3,661,423 to Garrett. Applicant respectfully disagrees that the claims are obvious in light of the cited art.

Claims 2225 and 2264 each describe a combination of features including: “providing heat from one or more heaters to at least a portion of the formation.” At least the above quoted feature, in combination with the other features of the claims, does not appear to be taught or suggested by the combination of Justheim with Hoekstra or Garrett. Applicant requests removal of the obviousness rejection of claims 2225 and 2264.

K. The Claims Are Not Obvious Over Justheim In View of Salomonsson or Camacho Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2230, 2231, 2268, and 2269 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,766,982 to Justheim as applied to claim 2193, and further in view of U.S. Patent No. 2,914,309 to Salomonsson (hereinafter “Salomonsson”) or U.S. Patent No. 4,067,390 to Camacho et al. Applicant respectfully disagrees with these rejections.

The rejected claims each describe a combination of features including: “providing heat from one or more heaters to at least a portion of the formation.” Justheim does not appear to teach or suggest the use of heaters. The combination of Justheim with Salomonsson or Camacho does not appear to teach or suggest all the features of the rejected claims. Applicant requests removal of the obviousness rejections of claims 2230, 2231, 2268, and 2269 in light of Justheim with Salomonsson or Camacho.

L. The Claims Are Not Anticipated By, Or Obvious Over Ljungstrom Pursuant To 35 U.S.C. § 102(b) or 103(a) Respectively

The Examiner rejected claims 2193-2195, 2199, 2200, 2203, 2205-2215, 2217, 2218, 2227, 2232-2234, 2238, 2239, 2242, 2244-2254, 2256, 2257, and 2265 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 2,923,535 to Ljungstrom (hereinafter “Ljungstrom”). Applicant respectfully disagrees with these rejections.

The Examiner states “Such permeability increase is deemed to necessarily or inherently encompass an increase to “greater than about 100 millidarcy” or “greater than about 5 Darcy”, as called for in claims 2193, 2226, 2265; alternatively, to increase the permeability to greater than 100 millidarcy or 5 Darcy would have been an obvious matter of choice in order to ensure adequate fluid flow through the formation.” Applicant respectfully disagrees with the rejections.

Applicant disagrees that the teachings and suggestions of Ljungstrom would necessarily or inherently encompass an increase in permeability as claimed in the present application. Ljungstrom does not appear to teach or suggest allowing the heat to transfer (e.g., controlling the heat input rate) to increase the permeability of the formation as claimed. Claim 2193 and the claims dependent thereon include the feature: “allowing the heat to transfer ... such that a permeability of at least a portion of the part of the formation increases to greater than about 100 millidarcy.” Claim 2232 and the claims dependent include the feature of: “allowing the heat to

transfer... such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform.” Ljungstrom does not appear to teach or suggest “allowing the heat to transfer” in a manner capable of achieving the claimed features, in combination with the other features of the claims. Allowing the heat to transfer in a manner capable of achieving the claimed features is not inherent, necessary or a matter of design choice based on the teachings or suggestions of Ljungstrom. Ljungstrom appears to teach or suggest heating the formation quickly substantially by the use of forced burning of a portion of the formation (combustion) towards a production well or wells. It appears that the burning of the formation would produce coke in the formation that would inhibit a substantially uniform permeability and/or a permeability greater than about 100 millidarcy.

M. The Claims Are Not Obvious Over Ljungstrom Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2201, 2202, 2204, 2219, 2222, 2228, 2229, 2240, 2241, 2243, 2258, 2261, 2266, 2267, 5396 and 5397 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 2,923,535 to Ljungstrom. Applicant respectfully disagrees with these rejections.

Claims 2201 and 2240 describe a combination of features including: “controlling the heat such that an average heating rate of a part of a formation is less than about 1 °C per day during pyrolysis.” Ljungstrom appears to teach or suggest combusting the formation towards production wells. Ljungstrom does not appear to teach or suggest at least the above quoted features of claims 2201 and 2240, in combination with the other features of the claims.

Claims 2202 and 2241 describes a combination of features including: “heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.” Ljungstrom does not appear to teach or suggest at least the above quoted feature of claims 2202

and 2241, in combination with the other features of the claims.

In the Office Action, the Examiner states: “The thermal conductivity is deemed an obvious matter of choice or design based on, e.g., the quality and type of the coal or oil shale formation present and/or the matrix characteristics of the particular coal or oil shale formation encountered in the field.” As discussed in Section F as regards Camacho, Applicant believes that “providing heat from one or more of the heaters” to achieve the desired thermal conductivity is not inherent, or an obvious matter of choice or design.

In the Office Action, the Examiner states: “The steps of 2219, 2222, 2228, 2258, 2261, 2266 such as controlling the heat or pressure in the formation, are deemed obvious matters of choice or design in carrying out the process of Ljungstrom, consistent with one of the overall objectives of Ljungstrom to control the heating process (col. 2, lines 25-55).” Applicant respectfully disagrees. As discussed in Section F as regards Camacho, Applicant believes that controlling the heat or pressure is not inherent, or an obvious matter of choice or design.

Claims 2222 and 2261 describe a combination of features including: “altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.” Applicant submits that at least the quoted features of claims 2222 and 2261, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Claims 2228 and 2266 describe a combination of features including: “controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by a Fischer Assay.” Applicant submits that at least the quoted features of claims 2228 and 2266, in combination with the other features of the claims, does not appear to be taught or suggested by the cited art.

In the Office Action, the Examiner states:

Regarding claims 2229, 2267, 5396 and 5397, Ljungstrom in the embodiment of Figures 2-5 and 9, discloses that myriad heating wellbores (20) may surround a production wellbore or shaft (26). The precise number of such heating well provided, as called for in these claims, is deemed an obvious matter of choice or design in carrying out the process of Ljungstrom based on, e.g., the overall areal extent of the coal or oil shale formation(s) encountered in exploiting an actual reservoir encountered in the field.

Applicant respectfully disagrees that the number of heater wells to production wells is an obvious matter of choice or design. Ljungstrom discloses:

Electrical heating elements 22 may be arranged in holes 20 in groups comprising six elements about a common gas exhaust passage 26, as will appear from Figures 2-5.

(Ljungstrom, column 2, lines 65-68).

Ljungstrom discloses:

In the holes in the corners of the hexagons were inserted electrical heating elements. A power of 10 kilowatts was evenly distributed over the part of the element, which was placed in the oil shale.

(Ljungstrom, column 4, lines 49-53).

Ljungstrom appears to teach 6 electrical heaters disposed in a formation about a production well in a hexagonal pattern. Ljungstrom does not appear to provide any suggestion or motivation for using 7 or more heaters per production well. In addition, Ljungstrom does not appear to teach or suggest varying the number of heaters based upon various factors described in Applicant's specification.

Applicant submits that the selection of the number of heater wells provided for a production well is not an obvious matter of choice or design but, rather, may be based upon non-obvious choices such as desired product composition, desired production rates, desired heating rates, etc. Claims 2229 and 2267 describe a combination of features including: "producing a mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well. Claims 5396 and 5397 describe a combination of features including:

“wherein at least about 20 heaters are disposed in the formation for each production well.” At least the above quoted features of claims 2229, 2267, 5396 and 5397, in combination with the other features of each claim, do not appear to be taught, suggested, or obvious in light of the cited art.

N. The Claims Are Not Obvious Over Ljungstrom In View of Tsai Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2216, 2220, 2221, 2255, 2259, and 2260 as being unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 2,923,535 to Ljungstrom as applied to claim 2193, in view of U.S. Patent No. 4,299,285 to Tsai et al. (“Tsai”). Applicant respectfully disagrees that the claims are obvious in light of the cited art.

The rejected claims describe combinations of features including: “allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of at least a portion of the part of the formation increases to greater than about 100 millidarcy” or “allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform” Applicant does not believe that the combination of Ljungstrom and Tsai teaches or suggests at least the above quoted features of the claims, in combination with the other features of the claims. Ljungstrom and Tsai do not appear to teach or suggest allowing heat to transfer to control a permeability characteristic. The specific features of the individual claims relating to hydrogen are not matters of obvious design or choice but are part of the claim as a whole. The combination of Ljungstrom and Tsai does not appear to teach or suggest the features related to hydrogen in combination with the other features of the claims.

Applicant requests removal of the obviousness rejection of claims 2216, 2220, 2221, 2255, 2259, and 2260.

O. The Claims Are Not Obvious Over Ljungstrom In View of Justheim Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2216, 2220, 2221, 2223, 2224, 2255, 2259, 2260, 2262, and 2263 as being unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 2,923,535 to Ljungstrom as applied to claim 2193, in view of U.S. Patent No. 3,766,982 to Justheim et al. Applicant respectfully disagrees with the rejections.

Applicant submits that features such as controlling and/or altering the pressure or heat as recited in claims 2216, 2220, 2221, 2223, 2224, 2255, 2259, 2260, 2262, and 2263 provides unexpected and/or improved results based on the prior art as outlined in Section F as regards Camacho and claims 2219-2222, 2228, 2258-2261, and 2266. Thus, Applicant submits that steps such as controlling and/or altering the pressure or heat as recited in claims 2216, 2220, 2221, 2223, 2224, 2255, 2259, 2260, 2262, and 2263 are not obvious matters of choice or design. Applicant respectfully submits that the rejected claims describe combinations of features, and that the combination of features are not taught, described, or obvious matters of choice or design in light of the combination of Ljungstrom and Justheim.

Applicant requests removal of the obviousness rejection of claims 2216, 2220, 2221, 2223, 2224, 2255, 2259, 2260, 2262, and 2263.

P. The Claims Are Not Obvious Over Ljungstrom In View of Justheim And Further in View of Hoekstra or Garrett Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2225 and 2264 as being unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 2,923,535 to Ljungstrom in view of U.S. Patent No. 3,766,982 to Justheim et al. as applied to claim 2223, and further in view of U.S. Patent No. 4,353,418 to Hoekstra et al. or U.S. Patent No. 3,661,423 to Garrett. Applicant respectfully disagrees that the claims are obvious in light of the cited art. Applicant does not believe that the combination of features of claims 2225 and 2264 are taught or suggested by the combination of Ljungstrom in

light of Justheim, or by the combination of Ljungstrom and Justheim in light of Hoekstra or Garrett. Applicant requests removal of the rejections of claims 2225 and 2264.

Q. The Claims Are Not Obvious Over Ljungstrom In View of Salomonsson or Camacho Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2230, 2231, 2268, and 2269 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 2,923,535 to Ljungstrom as applied to claim 2193, and further in view of U.S. Patent No. 2,914,309 to Salomonsson or U.S. Patent No. 4,067,390 to Camacho et al. Applicant respectfully disagrees with these rejections.

The rejected claims describe combinations of features including: “allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of at least a portion of the part of the formation increases to greater than about 100 millidarcy” or “allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform” Applicant does not believe that the combination of Ljungstrom and Salomonsson or Camacho teaches or suggests at least the above quoted features of the claims, in combination with the other features of the claims. Ljungstrom, Salomonsson and/or Camacho do appear to teach or suggest allowing heat to transfer to control a permeability characteristic. The specific features of the individual claims relating to well placement are not matters of obvious design or choice but are part of the claim as a whole. The combination of Ljungstrom and Salomonsson or Camacho does not appear to teach or suggest the features related to well placement in combination with the other features of the claims.

Applicant requests removal of the obviousness rejection of claims 2230, 2231, 2268, and 2269.

R. The Claims Are Neither Anticipated By, Nor Obvious Over Pelofsky Pursuant To 35 U.S.C. § 102(b) or 103(a)

The Examiner rejected claims 2193-2195, 2200-2203, 2205-2220, 2226, 2227, 2230-2234, 2239-2242, 2244-2259, 2265, 2268, and 2269 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,882,941 to Pelofsky (hereinafter "Pelofsky"). Applicant respectfully disagrees with these rejections.

The Examiner states "Pelofsky discloses heating an oil shale formation wherein over the course of heat injection, shut-in and production cycles, the oil shale formation will experience "a marked increase in permeability" (col. 2, lines 39-68). It is deemed that such permeability increase will inherently or obviously be substantially uniform, as called for in claims 2232 or 2227, insofar as the entire oil shale formation extent appears affected by the heating and shut-in cycles." Applicant respectfully disagrees.

Claims 2193 and 2232 describes combinations of features including: "providing heat from one or more heaters to at least a portion of the formation." Pelofsky appears to teach or suggest injection of hot fluids to heat a formation. Pelofsky does not appear to teach or suggest at least the quoted feature, in combination with the other features of the claims. Applicant requests removal of the rejections of claim 2193 and claim 2232, and the claims dependent thereon.

Applicant respectfully disagrees that many of the claims rejected by the Examiner are anticipated or obvious in light of Pelofsky. Applicant submits that many of the dependent claims rejected by the Examiner are independently patentable.

Claim 2226 recites, in part "further comprising increasing a permeability of a majority of the part of the formation to greater than about 5 Darcy." The quoted features of claim 2226, in combination with the other features of the claim, do not appear to be taught or suggested by the cited art.

Claim 2227 recites, in part “wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.” The quoted features of claim 2227, in combination with the other features of the claim, do not appear to be taught or suggested by the cited art.

Claims 2194 and 2233 describe a combination of features including: “wherein the one or more heaters comprise at least two heaters, and wherein controlled superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the part of the formation.” Applicant submits that at least the quoted features of claims 2194 and 2233, in combination with the other features of the claims, does not appear to be taught or suggested by Pelofsky.

Claims 2200 and 2239 describe a combination of features including: “further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.” Applicant submits that the quoted features of claims 2200 and 2239, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

Claims 2201 and 2240 describe a combination of features including: “controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis.” Applicant submits that the quoted features of claims 2201 and 2240, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

Claims 2202 and 2241 describe a combination of features including: “heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and wherein heating energy/day (P_{wv}) provided to the selected volume is equal to or less than $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk

density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.” Applicant submits that the quoted features of claims 2202 and 2241, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

In the Office Action, the Examiner states: “Regarding claims 2205-2218, 2220, 2228, 2244-2257, 2259, 2266 it is deemed that the myriad hydrocarbon product mixtures recited in these claims would necessarily or obviously occur in carrying out the in situ retorting process of Pelofsky, i.e., the precise composition of the product fluids is seen as dictated by the particular kerogen naturally occurring in the particular oil shale formation actually encountered in the field.” Applicant respectfully disagrees. The precise composition produced appears to be dictated by the method of treatment, as well as by the type of hydrocarbon material present.

Pelofsky discloses: “If the invention is carried out using the preferred embodiments described above, it is normally feasible to convert at least about 70 percent and frequently at least about 90 percent of the kerogen in the affected areas of the deposit into bitumen and to recover at least about 65 percent of such bitumen from the deposit.” (Pelofsky, column 4, lines 60-65). Pelofsky appears to teach or suggest producing bitumen from the formation. As stated in Applicant’s specification, ““Bitumen” is generally defined as a non-crystalline solid or viscous hydrocarbon material that is substantially soluble in carbon disulphide.” (Specification, page 38, lines 27-28). Claims 2205-2218, 2220, 2228, 2244-2257, 2259, and 2266 recite various product mixtures that would not be producible by carrying out the process of Pelofsky.

For example, claims 2206 and 2245 describe a combination of features including: “further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.” The quoted features of claims 2206 and 2245, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

Claims 2210 and 2249 describe a combination of features including: “further comprising

producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.” The quoted features of claims 2210 and 2249, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

Claims 2205 and 2244 describe a combination of features including: “further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.” The quoted features of claims 2205 and 2244, in combination with the other features of the claims, do not appear to be taught or suggested by the cited art.

Claims 2230 and 2268 describe a combination of features including: “providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.” The quoted features of claims 2230 and 2268, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

Claims 2231 and 2269 describe a combination of features including: “providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.” The quoted features of claims 2231 and 2269, in combination with the other features of the claims, do not appear to be taught or suggested by Pelofsky.

S. The Claims Are Not Obvious Over Pelofsky Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2204 and 2243 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,882,941 to Pelofsky. Applicant respectfully disagrees with these rejections.

The Examiner states in the office action: "The thermal conductivity recited in claims 2204 and 2243 is deemed an obvious matter of choice or design based on, e.g., the quality and amount of the kerogen present and/or the matrix characteristics of the particular oil shale formation encountered in the field." Applicant respectfully disagrees. Applicant submits that providing heat from one or more heaters such that a thermal conductivity of a portion of a formation is greater than about 0.5 W/(m °C) is unexpected based on literature in the art as outlined in Section F as regards Camacho. Applicant requests removal of the rejection of claims 2204 and 2243.

T. The Claims Are Not Obvious Over Pelofsky In View of Salomonsson Pursuant To 35 U.S.C. 103(a)

The Examiner rejected claims 2230, 2231, 2268, and 2269 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 3,882,941 to Pelofsky as applied to claim 2193 and 2232, and further in view of U.S. Patent No. 2,914,309 to Salomonsson. Applicant respectfully disagrees with these rejections.

The rejected claims describe combinations of features including: "allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of at least a portion of the part of the formation increases to greater than about 100 millidarcy" or "allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform" The combination of Pelofsky and Salomonsson does not appear to teach or suggest at least the quoted features of the rejected claims, in combination with the other features of the claims. Applicant requests removal of the obviousness rejections of the rejected claims.

U. The New Claims Are Not Anticipated or Obvious in view of the Cited Art

Applicant believes that new claim 5404, and the claims dependent thereon do not read on the cited prior art. For example, Camacho does not teach or suggest at least the feature of an interconnected pyrolysis zone, in combination with the other features of the claims. Many of the other cited references do not appear to teach or suggest at least the feature of the use of heaters, in combination with the other features of the claims.

V. Prior Art Made of Record

In the Office Action, the Examiner states: “It is noted that the reference to Bridges et al (4,144,935) also heats a subterranean oil shale formation to effect hydrocarbon fluids production, which heating also thermally fractures or increases the formation permeability (note col. 17, lines 15-45)....” Applicant respectfully disagrees. Applicant submits that Bridges does not appear to teach or suggest at least the feature of providing heat from one or more heaters to at least a portion of the formation and allowing the heat to transfer from one or more heaters to a part of the formation. The cited art does not appear to teach or suggest the combination of features of the pending claims.

In the Office Action, the Examiner states: “It is noted that the reference to Albaugh (2,685,930) also heats a subterranean oil shale formation to effect hydrocarbon fluids production, which heating also thermally fractures or increases the formation permeability (note col. 2, lines 7-35)....” Applicant respectfully disagrees. The cited art does not appear to teach or suggest the combination of features of the pending claims.

In the Office Action, the Examiner states: “It is noted that the reference to Sresty (4,485,869) also heats a subterranean oil shale formation to effect hydrocarbon fluids production, which heating also thermally fractures or increases the formation permeability (note col. 3, line 52 - col. 4, line 22; col. 9, lines 23-58)....” Applicant respectfully disagrees. Applicant submits that Sresty does not appear to teach or suggest at least the feature of providing heat from one or

more heaters to at least a portion of the formation and allowing the heat to transfer from one or more heaters to a part of the formation. The cited art does not appear to teach or suggest the combination of features of the pending claims.

In the Office Action, the Examiner states: "It is noted that the reference to Herzog (2,906,340) also heats a subterranean petroleum formation to effect hydrocarbon fluids production, which heating also thermally fractures or increases the formation permeability (note col. 3, lines 28-62)..." Applicant respectfully disagrees. Applicant submits that Herzog does not appear to teach or suggest at least the feature of providing heat from one or more heaters to at least a portion of the formation and allowing the heat to transfer from one or more heaters to a part of the formation. The cited art does not appear to teach or suggest the combination of features of the pending claims.

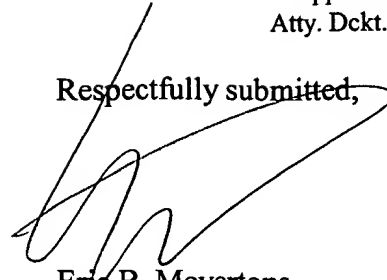
W. Conclusion

Applicant submits that all claims are in condition for allowance. Favorable reconsideration is respectfully requested.

A Fee Authorization is enclosed to cover fees for additional claims and for consideration of an Information Disclosure Statement. If any extension of time is required, Applicant hereby requests the appropriate extension of time. If any fees are required or have been overpaid, please appropriately charge or credit those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 50-1505/5659-02400/EBM.

Inventors: de Rouffignac et al.
Appl. Ser. No.: 09/841,000
Atty. Dckt. No.: 5659-02400

Respectfully submitted,



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Marked-Up Copy of the Amendments Submitted In Response To The Office Action

Mailed On July 9, 2002

In the Specification:

On page 39, the paragraph beginning on line 14.

As used herein, “a method of treating a hydrocarbon containing formation” may be used interchangeably with “an in situ conversion process for hydrocarbons.”

“Hydrocarbons” are generally defined as molecules formed primarily by carbon and hydrogen atoms~~organic material that contains carbon and hydrogen in their molecular structures~~. Hydrocarbons may also include other elements, such as, but not limited to, halogens, metallic elements, nitrogen, oxygen, and/or sulfur. Hydrocarbons may be, but are not limited to, kerogen, bitumen, pyrobitumen, and oils. Hydrocarbons may be located within or adjacent to mineral matrices within the earth. Matrices may include, but are not limited to, sedimentary rock, sands, silicilytes, carbonates, diatomites, and other porous media.

On page 64, the paragraph beginning on line 11:

As shown in FIG. 3, in addition to heat sources 100, one or more production wells ~~102-104~~ will typically be disposed within the portion of the coal formation. Formation fluids may be produced through production well 104. ~~Production well 102 may be configured such that a mixture that may include formation fluids may be produced through the production well.~~ Production well ~~102-104~~ may also include a heat source. In this manner, the formation fluids may be maintained at a selected temperature throughout production, thereby allowing more or all of the formation fluids to be produced as vapors. Therefore high temperature pumping of liquids from the production well may be reduced or substantially eliminated, which in turn decreases production costs. Providing heating at or through the production well tends to: (1) ~~prevent~~ inhibit condensation and/or refluxing of production fluid when such production fluid is moving in the production well

proximate to the overburden, (2) increase heat input into the formation, and/or (3) increase formation permeability at or proximate the production well.

In the Claims:

2193. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation; and

allowing the heat to transfer from ~~the one or more heat source~~heaters to a ~~selected section~~part of the formation such that a permeability of at least a portion of the ~~selected section~~part of the formation increases to greater than about 100 millidarcy.

2194. (amended) The method of claim 2193, wherein the one or more ~~heat source~~heaters comprise at least two ~~heat source~~heaters, and wherein controlled superposition of heat from at least ~~the two heat source~~heaters pyrolyzes at least some hydrocarbons within the ~~selected section~~part of the formation.

2195. (amended) The method of claim 2193, further comprising maintaining a temperature within the ~~part of the formation~~selected section within a pyrolysis temperature range.

2196. (amended) The method of claim 2193, wherein at least one of the one or more ~~heat sources~~heaters comprises an electrical heaters.

2197. (amended) The method of claim 2193, wherein at least one of the one or more ~~heaters~~heat sources comprises a surface burners.

2198. (amended) The method of claim 2193, wherein at least one of the one or more ~~heaters~~heat sources comprises a flameless distributed combustors.

2199. (amended) The method of claim 2193, wherein at least one of the one or more heaters ~~heat sources~~ comprises a natural distributed combustors.

2200. (amended) The method of claim 2193, further comprising controlling a pressure and a temperature within at least a majority of the ~~selected section~~ part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

2201. (amended) The method of claim 2193, further comprising controlling the heat such that an average heating rate of the part of the formation ~~selected section~~ is less than about 1 °C per day during pyrolysis.

2202. (amended) The method of claim 2193, wherein providing heat from ~~the one or more of the heat source~~ heaters to at least the portion of formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from ~~the one or more of the heat source~~ heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day ~~wherein heating energy/day provided to the volume is equal to or less than P_{wr} , wherein P_{wr} is calculated by the equation:~~

~~———— $P_{wr} = h * V * C_v * \rho_B$~~

~~———— wherein P_{wr} is the heating energy/day, h is an average heating rate of the formation, ρ_B is formation bulk density, and wherein the heating rate is less than about 10 °C/day.~~

2204. (amended) The method of claim 2193, wherein providing heat from ~~the one or more of the heat source~~ heaters comprises heating the part of the formation ~~selected~~

~~section~~ such that a thermal conductivity of at least a portion of the part of the formation~~selected section~~ is greater than about 0.5 W/(m °C).

2219. (amended) The method of claim 2193, further comprising controlling a pressure within at least a majority of the ~~selected section~~part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

2224. (amended) The method of claim 2193, further comprising:
providing hydrogen (H₂) to the heated part of the formation~~section~~ to hydrogenate hydrocarbons within the part of the formation~~section~~; and
heating a portion of the part of the formation~~section~~ with heat from hydrogenation.

2226. (amended) The method of claim 2193, further comprising increasing a permeability of a majority of the part of the formation~~selected section~~ to greater than about 5 Darcy.

2227. (amended) The method of claim 2193, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation~~selected section~~.

2228. (amended) The method of claim 2193, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by ~~the a~~ Fischer Assay.

2229. (amended) The method of claim 2193, further comprising producing a mixture in a production well, wherein at least about 7 ~~heat source~~heaters are disposed in the formation for each production well.

2230. (amended) The method of claim 2193, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, and wherein the unit of ~~heat source~~heaters comprises a triangular pattern.

2231. (amended) The method of claim 2193, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, wherein the unit of ~~heat source~~heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

2232. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more ~~heat source~~heaters to at least a portion of the formation; and

allowing the heat to transfer from one or more heaters to a part of the formation such that a permeability of a majority of at least a portion of the part of the formation increases and such permeability is substantially uniform.~~allowing the heat to transfer from the one or more heat sources to a selected section of the formation such that a permeability of a majority of at least a portion of the selected section increases substantially uniformly.~~

2233. (amended) The method of claim 2232, wherein the one or more ~~heat source~~heaters comprise at least two ~~heat source~~heaters, and wherein controlled superposition of heat from at least ~~the two heat source~~heaters pyrolyzes at least some hydrocarbons within the ~~selected section~~part of the formation.

2234. (amended) The method of claim 2232, further comprising maintaining a temperature within the ~~part of the formation~~selected section within a pyrolysis temperature range.

2235. (amended) The method of claim 2232, wherein at least one of the one or more ~~heaters~~ ~~heat sources~~ comprises an electrical heaters.

2236. (amended) The method of claim 2232, wherein at least one of the one or more ~~heaters~~ ~~heat sources~~ comprises a surface burners.

2237. (amended) The method of claim 2232, wherein at least one of the one or more ~~heaters~~ ~~heat sources~~ comprises a flameless distributed combustors.

2238. (amended) The method of claim 2232, wherein at least one of the one or more ~~heaters~~ ~~heat sources~~ comprises a natural distributed combustors.

2239. (amended) The method of claim 2232, further comprising controlling a pressure and a temperature within at least a majority of the ~~selected section~~ part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

2240. (amended) The method of claim 2232, further comprising controlling the heat such that an average heating rate of the part of the formation ~~selected section~~ is less than about 1 °C per day during pyrolysis.

2241. (amended) The method of claim 2232, wherein providing heat from ~~the one or more~~ of the heat source ~~heaters~~ to at least the portion of formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from ~~the one or more~~ of the heat source ~~heaters~~, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day ~~wherein heating energy/day~~

~~provided to the volume is equal to or less than P_{wr} , wherein P_{wr} is calculated by the equation:~~

~~———— $P_{wr} = h * V * C_v * \rho_B$~~

~~———— wherein P_{wr} is the heating energy/day, h is an average heating rate of the formation, ρ_B is formation bulk density, and wherein the heating rate is less than about 10 °C/day.~~

2243. (amended) The method of claim 2232, wherein providing heat from ~~the one or more of the heat source heaters~~ comprises heating the part of the formation~~selected section~~ such that a thermal conductivity of at least a portion of the part of the formation~~selected section~~ is greater than about 0.5 W/(m °C).

2258. (amended) The method of claim 2232, further comprising controlling a pressure within at least a majority of the ~~selected section~~part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

2263. (amended) The method of claim 2232, further comprising:

providing hydrogen (H_2) to the heated part of the formation~~section~~ to hydrogenate hydrocarbons within the part of the formation~~section~~; and

heating a portion of the part of the formation~~section~~ with heat from hydrogenation.

2265. (amended) The method of claim 2232, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation~~selected section~~ to greater than about 100 millidarcy.

2266. (amended) The method of claim 2232, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by ~~the~~ a Fischer Assay.

2267. (amended) The method of claim 2232, further comprising producing a mixture in a production well, wherein at least about 7 ~~heat source~~heaters are disposed in the formation for each production well.

2268. (amended) The method of claim 2232, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, and wherein the unit of ~~heat source~~heaters comprises a triangular pattern.

2269. (amended) The method of claim 2232, further comprising providing heat from three or more ~~heat source~~heaters to at least a portion of the formation, wherein three or more of the ~~heat source~~heaters are located in the formation in a unit of ~~heat source~~heaters, wherein the unit of ~~heat source~~heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

5396. (amended) The method of claim 2229, wherein at least about 20 ~~heat source~~heaters are disposed in the formation for each production well.

5397. (amended) The method of claim 2267, wherein at least about 20 ~~heat source~~heaters are disposed in the formation for each production well.